days previously moderate shocks were felt near Charleston. From the Carolinas it radiated with great rapidity (from 20 to 60 miles a minute) throughout the great area bounded on the south by the Gulf of Mexico; on the north by Michigan, the province of Ontario, New York, and southern New England; on the east by the Atlantic ocean, where it was probably felt nearly 500 miles at sea; and on the west by the central Mississippi valley. The limits are, so far as now known, as follows: central Florida; eastern Louisiana, Arkansas, Missouri, and Iowa; southern Michigan and province of Ontario; northern New York; and southern New England. It was not felt at Bermuda. The limits of the shock, as here stated and as indicated in the accompanying map, it is particularly desirable to verify, as well as the correct time at which the shock was first felt at all points within the disturbed area. It often happens that there are places within an earthquake area where the shock is not perceptible, owing probably to some local peculiarity in the geological formation, although decidedly noticeable at places not far away. There are already points of this kind mentioned, — in Florida, Indiana, and Connecticut, for instance, — and such information is very interesting.

The hypothesis has been advanced by Perrey that earthquakes are connected with subterranean tides due to the combined influence of the sun and moon, and analogous to those in the ocean. At a given point the earth's strata are under the accumulated tension of centuries, and this pressure is slowly but steadily increasing, until it reaches a point when fracture is imminent. Twice a day the great oceanic tidal waves sweep along the coast, the tremendous changes of pressure due to them being possibly augmented by analogous movements beneath the crust; and at a critical moment they add 'the last straw' that determines the fracture. It is very interesting to notice in this connection that at the time of the severe shock at Charleston this tidal influence was at its maximum. The moon was in perigee at 2 A.M., Aug. 29; new moon at 8 A.M. the same day, acting in a direct line with the sun (the eclipse of the sun occurred at 5 A.M., Aug. 29): extremely high tides occurred, therefore, for several days following. The moon's upper transit at Charleston occurred at 2.22 P.M., on Aug. 31. The high tide following (the higher of the two daily tides) was at 9.35 P.M., just twenty minutes before the shock occurred. This remarkable coincidence is of course extremely interesting.

It seems remarkable that no sea-wave followed the shock; and indeed it was providential that it did not, as the resulting destruction and loss of life would have been a hundredfold greater. A sea-wave (often very incorrectly called a tidal wave) of greater or less size is the almost invariable accompaniment of a severe shock occurring near the seacoast.

It is unnecessary to enlarge here and now upon the general effects of this severe earthquake, or to theorize upon the causes of earthquakes in general or of this one in particular, more than has already been done. Such a study, to be of any value, must await the compilation and elaboration of a vast amount of material, and the final reports of the geologists who are now at work in the region of greatest disturbance.

## *STUDY OF THE EARTHQUAKE.*

THE U. S. geological survey has undertaken to make a study of the severe earthquake of Aug. 31, which caused such great destruction and loss of life at Charleston, S.C. It was the most severe on record in the United States, both as to the effects produced and the area disturbed.

The study of phenomena of this kind is of the greatest value to science as a guide to the knowledge of the nature of the interior of the globe, and in its bearing upon every branch of physics and geology. In it there is needed a vast amount of reliable information, not only from points within the disturbed area, but also from adjacent points, in order to accurately define its limits; and it is not only skilled observers who can furnish such information, but almost every one can contribute valuable facts. It is therefore confidently hoped that facts of interest will be sent in at once to the U. S. geological survey at Washington while they are still fresh in the memory. Newspapers can render great assistance by giving wide publicity to this call, and by sending copies of their issues containing information about the local effects of the shock. Attention to the points mentioned below will add greatly to the value of the information, and facilitate its elaboration and study.

Write on one side only of the paper. After dating the letter as usual (giving also the locality where the observation was made, if not the same), write 'Answers to circular No. 2.' State the observer's situation (whether in the house or out of doors, up stairs or down, sitting, standing, walking, reading, etc.); also, if possible, the character of the ground (whether rocky, earthy, sandy, etc.) Then answer the following questions, referring to them by number only: —

1. Was an earthquake felt at your place the evening of Aug. 31, 1886, or within a few days of that time? Negative answers to this will be of great

interest from any points within the disturbed area, and especially from points near its limits; that is, southern Florida; central Mississippi, Arkansas, Missouri, and Iowa; south-eastern Minnesota and Wisconsin; central Michigan; southern portion of the province of Ontario; northern New York; southern Vermont and New Hampshire; and eastern Massachusetts; also from the western part of the Atlantic and northern part of the Gulf.

2. At what hour, minute, and second of standard time was it felt? When this can be accurately given, it is of the very greatest importance. Be particularly careful to state whether it is standard (railway) time or local time; whether the watch or clock was compared with some standard clock at a railway-station or elsewhere, how soon, what the error was, and whether you corrected your observation by this comparison or not.

3. How long did its perceptible motion continue?

4. Was it accompanied by any unusual noise? If so, describe it.

5. Was there more than one shock felt? If so, how many? Where several were felt, give accurately, or even roughly, the number, duration, and character of each, and the interval between them.

6. Which of the following measures of intensity would best describe what happened in your vicinity? — No. 1. Very light; noticed by a few persons; not generally felt. No. 2. Light; felt by the majority of persons; rattling of windows and crockery. No. 3. Moderate; sufficient to set suspended objects, chandeliers, etc., swinging, or to overthrow light objects. No. 4. Strong; sufficient to crack the plaster in houses or to throw down some bricks from chimneys. No. 5. Severe; overthrowing chimneys, and injuring the walls of houses.

7. Do you know of any other cause for what happened than an earthquake? Give also any further particulars of interest, stating whether they are from observation or hearsay: for instance, whether the shock seemed like a tremor or jar, or an undulatory movement; and whether it seemed to come horizontally or vertically; whether any idea of direction of shock was formed, and if people agreed in their idea as to such direction. Mention any unusual condition of the atmosphere; any strange effects on animals (it is often said that they will feel the first tremors of a shock some time before people notice it at all); character of damage to buildings; general direction in which walls, chimneys, etc., were overthrown. Springs, rivers, and wells are often noticeably affected by even slight shocks, and such facts are especially interesting. If a clock was stopped, give the time it indicated, and some idea as to how fast or how slow it was, its position, the direction in which it was standing or facing, and the approximate weight and length of the pendulum. If a chandelier was noticed to swing decidedly, describe it and state direction of swing. If pictures swung, state direction of wall, and whether pictures on the wall at right angles to it were also put in motion. If doors were closed or opened, state the direction of the wall in which they were set. All such little facts, if only noticed, remembered, and recorded, are of great value.

At end of letter give name of the observer, if other than the writer. A moment's thought will show the impossibility of an immediate acknowledgment of every letter received, although each one will have its share in contributing to the value of the result, as it finally appears in the public press and the official publications of the survey.

Address simply, Division of volcanic geology, U. S. geological survey, Washington, D.C.

EVERETT HAYDEN, *Assistant Geologist.*

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## *THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

THE French association for the advancement of science held its fifteenth annual meeting in Nancy, the 12th of August and the week following. Nancy, one of the frontier towns, near the German limit, is a very handsome and pleasant city. It is very prettily built, and contains old monuments of a striking effect. It is also a scientific and literary town, and many able *savants* or writers hold a position in the university. The meeting was a very successful one, in that a large number of members were present, and the papers submitted were numerous and satisfactory. The president was M. Friedel, the well-known chemist, the successor of Würtz in the Sorbonne, and one of his best and most affectionate pupils. In his address to the meeting the first day, he made it known that the Association scientifique, founded by Leverrier, is to be soon combined with the French association under the name of the latter. The greater part of M. Friedel's address was concerning recent progress in chemistry and mineralogy. After having recalled M. Moissan's successful experiment, by which fluor has been isolated for the first time, and M. Lecoq de Boisbaudran's interesting researches concerning two new metals, he spoke at length on the artificial synthesis of different compounds, such as those of felspars and some precious stones. After M. Friedel's address, M. Collignon, the secretary-general, briefly recalled the principal points of the association's history for the past